

tion of iodinated contrast materials. Concurrent peripheral MRI venography can also be done to evaluate for the presence of deep venous thrombi. The ability to evaluate for both pulmonary embolism and deep venous thrombosis in less than an hour makes MRI an attractive modality in the diagnosis of thromboembolic disease.

Unfortunately, the hardware and software necessary to produce clinically useful images of the pulmonary vascular tree are not yet widely available or widely used. Spiral CT is more widely available and can better evaluate the lung parenchyma and mediastinum as well as the pulmonary vasculature. Therefore, it can detect other disease processes that could mimic pulmonary embolism on ventilation-perfusion scans.

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## Magnetic Resonance Imaging of Radiographically Occult Bony Trauma

SUBSTANTIAL BONY INJURIES related to acute trauma or repetitive stress may not be detected on plain radiographs. Magnetic resonance imaging (MRI) has proved to be a powerful tool to assess these radiographically occult injuries, primarily because of its ability to show associated changes in the underlying marrow.

Trabecular bone is commonly injured during athletic activities. "Bone bruises" may be the sole cause for a patient's symptoms, and occasionally may result in adverse long-term sequelae if not treated appropriately. Plain radiographs are notoriously insensitive for detecting trabecular injuries because the overlying cortex is often intact. Because of its exquisite soft tissue contrast, MRI is able to depict the associated marrow hemorrhage or edema. Its ability to display concomitant soft tissue injuries is one advantage of this technique compared with radionuclide bone scanning.

Nondisplaced fractures may also be missed on plain films. Occult hip fractures in elderly patients present a particular diagnostic challenge because a radionuclide bone scan may be normal for the first few days after injury in these patients. Again, because of its sensitivity for detecting associated marrow changes, MRI can rapidly detect occult fractures with a high degree of accuracy. Similarly, a normal MRI virtually excludes serious bony injury, thereby allowing efficient patient evaluation. If a limited protocol is used, this technique can be cost-competitive with other modalities such as a radionuclide bone scan, often with greater specificity.

Stress fractures are becoming more common in our increasingly active society. Rapid, accurate diagnosis is

important because clinical assessment can be difficult, and biopsy in the early stages of stress injury may result in a mistaken diagnosis of neoplasm due to the presence of immature cells related to the reparative process. Plain radiographs are insensitive in these early stages, but MRI is able to detect the associated marrow changes and sometimes a distinct fracture line as well, before the typical periosteal reaction or fracture is detectable on plain films. As such, it is a useful diagnostic adjunct when a radionuclide bone scan is indeterminate.

Although the use of MRI has come under scrutiny because of current economic forces, it may prove to be the most cost-effective means for arriving at a rapid and accurate diagnosis in a patient with a radiographically occult bony injury.

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## Magnetic Resonance Imaging of the Breast

MAGNETIC RESONANCE (MR) mammography has been under technical and clinical evaluation for more than 14 years. Although initial data clearly indicate the suitability of MR imaging of the female breast, the use of MR mammography in evaluating breast disease has yet to be fully realized. Current applications are limited to the diagnosis of cancer in selected patients, the staging of known breast cancer, and the evaluation of silicone implant integrity.

Magnetic resonance mammography has undergone extensive evaluation as a noninvasive means for distinguishing between benign and malignant breast lesions identified by conventional mammography. Among the currently available imaging modalities—mammography, sonography, thermography, and computed tomography (CT)—only the use of mammography has been able to show a substantial reduction in the mortality associated with breast cancer, particularly for women older than 50 years. By using repetitive MR imaging of the same slices before and at short intervals after the administration of a contrast medium, known as "dynamic MR mammography," an 88% to 100% sensitivity in differentiating benign from malignant lesions has been reported. In the absence of contrast enhancement, a carcinoma can be excluded with a high degree of certainty.

The greatest enthusiasm for MR mammography in evaluating breast disease is as a screening tool for the large number of women with mammographically dense breasts and a relatively increased risk for breast cancer due to a strong family history of the disease.